

Amendments to the Drawings:

In FIG. 12A, the spelling of judgment is corrected in block S5. In FIG. 18A, the spelling of boundary is corrected in blocks S4-2 and S6-2.

Attachments: Two drawing sheets replacing original sheets 6/13 and 10/13

REMARKS

In the Office Action dated December 11, 2008, the Examiner rejects claims 1-30 under 35 U.S.C. §103(a). With this Amendment, claims 3-6, 12-15 and 19-30 are amended. No claims are added or canceled. After entry of this Amendment, claims 1-30 are pending in the Application. Reconsideration of the Application as amended is respectfully requested.

Applicant has amended the specification to correct several typographical and grammatical errors. Applicant submits that these changes merely conform the corrected portions of the specification to the remainder thereof and the drawing figures as originally filed.

Applicant has also corrected the spelling of judgment in block S5 of FIG. 12A and corrected the spelling of boundary in blocks S4-2 and S6-2 in FIG. 18A. Entry of the corrected drawing sheets is respectfully requested.

Applicant has further made a number of corrections to the claims. Each of claims 3-6, depending from claim 1, has been amended to clarify antecedent basis. Similarly, claims 12-15, which depend from claim 10, have been amended to clarify antecedent basis. The preamble of independent claim 19 has been amended to provide antecedent basis for the road feature in the body thereof, while its dependent claims 20-24 have been amended for clarity and antecedent basis. Independent claim 25 has been amended in one location to correct antecedent basis, and its dependent claims 26-30 have been similarly amended to correct antecedent basis.

In the Office Action dated December 11, 2008, the Examiner rejects claims 1-30 under 35 U.S.C § 103(a) as being unpatentable over Sasaki et al. (US 6,466,684) in view of Yoshida (JP 10-214326). Applicant respectfully submits that the recited combination fails to teach or suggest the features of independent claims 1, 10, 19 and 25 and their dependent claims.

The process of Sasaki et al. involves acquiring two successive images (FIG. 3, S1 and S2) and estimating the lane of the driver (S3). To estimate the lane of the driver (see FIG. 4), the image obtained in S2 is divided into small regions (S3-1). (FIG. 5B and col. 9, ll. 35-38). Then, using the virtual focus of expansion (FOE) obtained in S3-4 for each small

region of the previous image obtained in S1, candidates for the white line are extracted for each region (S3-2 and col. 9, ll. 51-56). The FOE for each small region is the crossing point of the lines extending from left and right line segments in a respective region. (Col. 10, ll. 9-17 and FIG. 7). The time interval between the images taken in S1 and S2 is minute so that the FOE does not change significantly from one image to the next. (Col. 9, ll. 56-58; col. 11, ll. 15-16; col. 12, ll. 15-17). More specifically, the edge extraction in S3-2 uses the FOE for each respective region as shown with respect to FIGS. 8A and 8B. Around the coordinate of each FOE, a fan-like region at a small angle is rotated about the point, and edge extraction is carried out for each fan-like region. (Col. 11, ll. 5-10). If the number of edges exceeds a threshold value, the edges are taken as a group of edges of the candidate white line. (Col. 11, 10-13).

Determination of line segments that appear to be the white line(s) in S3-3 occurs in one of two ways. In a first method, shown in FIG. 10, line segments for each of the small regions are successively compared in order from small region no. 1 to no. 5. That is, left and right segments are separately compared to determine if they are coupled from one small region to the next (without interruption). (Col. 11, ll. 40-46 and col. 11, line 60 to col. 12, line 1). In the second method, shown in FIG. 11, a combination of left and right segments is selected rather than selecting the two left and right segments individually. (Col. 12, ll. 10-14). Since the FOE between successive images should not change to any significant degree, an intersection point of each set of edges in a small region is calculated (both xy coordinates and angle) and compared to those for the FOE for the respective small region in the previous (S1) image. (Col 12, ll. 15-27). The left and right segments having the highest probability of being the white lines are selected together as a single combination for respective small regions. (Col. 12, ll. 28-33).

As shown in FIG. 12, one's own lane is finally determined in step S3 of FIG. 3 by defining the lane as a region around the line segments defining the white lines as shown in FIG. 12. This region is the monitoring range where the optical flow should be detected. (Col. 14, ll. 8-10). Problems with processing time and detecting accuracy are not solely resolved by searching the pixels corresponding to the monitoring range defined in step S3. (Col. 14, ll. 15-20). Therefore, detecting optical flow in step S4 of FIG. 3 is performed as

described with respect to FIG. 13. First, feature point(s) are extracted in S4-1 when pixels whose optical flows should not be detected are removed to a maximum degree. (Col. 14, ll. 3-6, 41-48 and FIGS. 14A-14I). Then, limiting the direction of searching occurs to minimize object detection processing in S4-2. (FIG. 19).

As can be seen from this description, Sasaki et al. fails to teach or suggest any of a controller adapted to compute velocity information for each pixel in an image as described in independent claims 1 and 10, velocity information computing means for processing the image to compute velocity information for each pixel in the image as described in independent claim 19, or computing a velocity component for each pixel in the image as described in independent claim 25. In fact, Sasaki et al. uses the road edges to narrow the search region for objects to minimize the velocity information that must be calculated. (FIGS. 13, 14A-14I, 19; col. 14, ll. 8-20 and 41-48).

Further, Sasaki et al. fails to teach or suggest the feature of claims 1 and 10 of a controller adapted to detect oblique lines composed of those extracted pixels having a velocity component, the feature of claim 19 of oblique line detecting means for detecting oblique lines made of pixels having a velocity component and extracted by the pixel extracting means and the feature of claim 25 of detecting oblique lines made of extracted pixels having a velocity component because Sasaki et al. fails to calculate any velocity until after all the road boundary lines are extracted. In fact, as shown in FIG. 14I, once the edges are detected, they are ignored in the calculation of velocity of objects in the image. (See also col. 15, ll. 40-57).

Applicant respectfully submits that Yoshida fails to cure these deficiencies in Sasaki et al. More specifically, Yoshida is directed to control of an automatic transit car that automatically directs the car along a roadway edge. (§[0001]). To do so, Yoshida first takes an image ahead of the automatic transit car 6 by image pickup means 7. (§[0016]). The image so obtained is compressed by subtracting the minimum brightness value for each 4X4 block from a maximum brightness value for that block. (See FIG. 3). The edge starts to be detected as shown in FIG. 11 by detecting the brightest of values of the compressed image (§[0019]), but the present invention refines this analysis by using a discriminant analysis method to divide the edge data into two classes—edge data and noise—through the

calculation of a threshold t . ([0020]-[0021] and FIG. 4). That is, in roadway region detection (also called ripple processing), the surface image immediately in front of the automatic transit car 6 that is below threshold t is extended as shown in FIG. 12 and as described in paragraphs [0023] to [0027]. The image obtained shows the entire road in the viewing region. (See FIG. 12). Edges are extracted as shown in FIG. 13 based on concentration values. ([0028]-[0029] and FIG. 6). Hough transformation of the data of FIG. 13 occurs to obtain FIG. 14, that is, the left edge of the roadway. ([0033]). In this manner, the roadway edge (white line 1a) is detected, and the deflection between the white line 1a and the direction of travel of the automatic transit car 6 is used to control a steering motor. ([0056]).

Applicant submits that, based on the Examiner's statement of the teachings of Yoshida (Office Action, p. 3), it is completely unclear how the Examiner believes Yoshida teaches any missing elements of Sasaki et al. with respect to the claims of the present invention. Yoshida detects only one edge, the controlling edge for the automatic steering, and is completely unrelated to object detection. The road edge in Yoshida is detected by brightness values, not movement of values over successive images.

For the foregoing reasons, Applicant respectfully submits that claims 1-30 are allowable over the combination of Sasaki et al. and Yoshida.

Applicant further submits that the cited art, either alone or in any permissible combination, fails to teach or suggest features of claims dependent from claims 1, 10, 19 and 25.

With respect to dependent claims 2, 11, 20 and 26, Applicant respectfully submits that the Examiner is incorrect regarding the teachings of Sasaki et al. (Office Action, p. 3) because the oblique lines of Sasaki et al. are shown as lacking bilateral symmetry as in straight roads and, more importantly, no velocity direction for either line is calculated or used in a determination of whether detected oblique lines are road boundaries.

Similarly, and with respect to dependent claims 3, 12, 21 and 27, slopes of the oblique lines are not determined in Sasaki et al. (Office Action, p. 4). Angles between oblique lines as measured from respective virtual FOEs of those lines for each small region nos. 1-5 are determined, but these angles are not compared to each other with respect to the

center of the image. (See FIG. 11). Instead, these angles are compared to angles calculated in a previous image to select the road boundary for a respective small region.

While pitch is mentioned in Sasaki et al., no change point as described in claims 4, 13, 22 and 28 is taught or suggested. (Office Action, p. 4). This is because the velocity direction of an oblique line is never calculated in Sasaki et al. Pitch angle in Sasaki et al. is presumably measured directly. (See FIG. 15 and col. 14, ll. 51-60).

With respect to claim 6, 15, 23 and 29, pitch angle, among other things, is used to transform the oblique lines into a real space road model in Sasaki et al. (Office Action, pp. 4-5). However, the risk of collision between the vehicle and a moving object is not based on the relative positional relationship between the road boundary and the moving object as established in the real space road model. Instead, the moving object is assessed based on its optical flow, which indicates its relationship to the FOE, distance from the vehicle and the relative speed of the vehicle and object. (Col. 16, line 61- col. 17, line 4).

Applicant acknowledges that Sasaki et al. generates a warning to the driver. (Office Action, p. 5). However, Applicant submits that there is no teaching or suggestion of a plurality of values corresponding to collision risk levels as described in dependent claims 7, 16, 24 and 30. Only one value N is calculated at a time to make the determination of whether to issue a warning based on system and environmental conditions. (Col. 17, line 5- col. 18, line 25). Further, claim 24 describes risk avoidance means for controlling the vehicle to avoid a collision between the vehicle and the moving object according to the degree of risk assessed by the degree of collision danger judgment means and claim 30 describes generating a signal to control the vehicle to avoid a collision between the vehicle and the moving object according to the collision danger judgment. Sasaki et al. fails to teach or suggest controlling the vehicle in any way in response to a collision danger. Instead, Sasaki et al. merely signals the driver to take action.

Finally, contrary to the Examiner's position (Office Action, p. 5), Sasaki et al. does not teach or suggest an automatic braking device operatively coupled to the controller and activated by a collision danger signal as required by claims 9 and 18. In Sasaki et al., the word "brake" is never used, and "braking" is described only in the context of describing action by another driver that might cause a collision. (Col. 1, line 25).

None of these deficiencies are cured by the addition of Yoshida to Sasaki et al. because Yoshida also fails to teach or suggest these features of dependent claims 2-4, 6, 7, 9, 11-13, 15, 16, 18, 20-24 and 26-30. Accordingly, in addition to their dependency from allowable independent claims, each of these claims is allowable based on the additional inventive features described therein.

It is submitted that this Amendment has antecedent basis in the Application as originally filed, including the specification, claims and drawings, and that this Amendment does not add any new subject matter to the Application. Consideration of the Application in view of these comments is requested. It is submitted that the Application is in suitable condition for allowance; notice of which is requested.

If the Examiner feels that prosecution of the present application can be expedited by way of an Examiner's amendment, the Examiner is invited to contact the undersigned at the telephone number listed below.

Respectfully submitted,

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